Transactions of the Royal Society of S. Aust. (1993), 117(2), 97-104.

FEMALES AND IMMATURES OF THE AUSTRALIAN CADDISFLY *HYALOPSYCHE DISJUNCTA* NEBOISS (TRICHOPTERA), AND A NEW FAMILY PLACEMENT

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Summary

WELLS, A. & CARTWRIGHT, D. (1993) Females and immatures of the Australian caddisfly *Hyalopsyche disjuncta* Neboiss (Trichoptera), and a new family placement. *Trans. R. Soc. S. Aust.* 117(2), 97-104, 4 June, 1993.

The female, larva and pupa of the northeastern Australian *Hyalopsyche disjuncta* Neboiss, 1980, are figured and described for the first time. Comparisons between *Hyalopsyche disjuncta* and several North American species of *Phylocentropus* Banks, 1907 (Family Dipseudopsidae Ulmer, 1904), show that both genera share apomorphous larval features. Transferral of *Hyalopsyche* Ulmer, 1904, from the family Hyalopsychidae Lestage, 1925, to the family Dipseudopsidae and supression of Hyalopsychidae are proposed.

KEY WORDS: Trichoptera, Dipseudopsidae, *Hyalopsyche*, larvae, pupae, females.

Introduction

The history of unstable taxonomy of the group of polycentropodid-like caddisfly genera including *Dipseudopsis* Walker, 1852, *Protodipseudopsis* Ulmer, 1904, *Phylocentropus* Banks, 1907, and *Hyalopsyche* Ulmer, 1904, is discussed in detail by Weaver & Malicky (in ms). These authors present strong support for the familial status of Dipseudopsidae, including the first three of the above-mentioned genera, and possibly also *Hyalopsyche*, an African-Oriental genus, which was placed by Schmid (1980) with *Phylocentropus* in the family Hyalopsychidae. Convincing evidence for the monophyly of Dipseudopsidae Ulmer, 1904, *sensu* Weaver & Malicky, derives from a consideration of features of the female abdomens and larvae.

Although reference has been made in the past to females of *Hyalopsyche* (Ulmer (1915) identified three New Guinean female specimens as *H. rivalis* (Betten, 1909)), no descriptions of females are available, and until now no larvae have been associated.

A single Australian species of *Hyalopsyche*, *H. disjuncta* Neboiss, was described by Neboiss (1980) from two adult males from northern Queensland. Repeated efforts to collect more specimens, including larvae, failed; *H. disjuncta* appeared to be rare. Recently, however, during an intensive collecting trip of two week's duration in the Jardine River area of far northern Cape York (as part of the Royal Geographic Society of Queensland's "Wet Season" Cape York Peninsula Scientific Expedition), the authors collected numerous adults of both sexes, and just prior to departure, made the exciting find of several larvae and pupae. Female and larval and pupal features of this species are here described and illustrated, and the larval niche is described. For comparisons, some larval features of *Phylocentropus* sp., and the female genitalia and head showing the tentorium of the North American *P. lucidus* (Hagen) are also figured.

Confirmation of sharing of the specialised larval niche and other synapomorphous larval character states, firmly supports the monophyly of *Phylocentropus* — *Hyalopsyche*, and we present an hypothesis for the derivation of the specialised female genitalia of *Hyalopsyche* from those of *Phylocentropus*. We argue that *Hyalopsyche* should be placed in the family Dipseudopsidae *sensu* Weaver & Malicky (in ms), and the name Hyalopsychidae is here supressed.

Ross (1965) and Ross & Gibbs (1973) discussed the phylogenetic relationships of Dipseudopsinae (in the Psychomyiidae and subsequently in the Polycentropodidae), but with more data available, phylogenetic analyses of higher taxa of Trichoptera now in progress (Weaver & Frazer pers. comm.) should provide a more definitive assessment of the relationships of this family.

Materials and Methods

Adult *Hyalopsyche disjuncta* were taken mainly at 12v or 8v black or UV lights; adults and larvae were collected into and stored in 70% ethanol. Comparative material of the North American *Phylocentropus lucidus* (adults) was provided by Dr J.S. Weaver, and adults of *P. placidus* and *Dipseudopsis indicus* and larvae of *Phylocentropus* sp. were provided on loan by Dr J. Morse.

Specimens were prepared for study by treatment in caustic potash, or using a lacto-phenol preparation. Drawings were made using camera lucidas on a Wild

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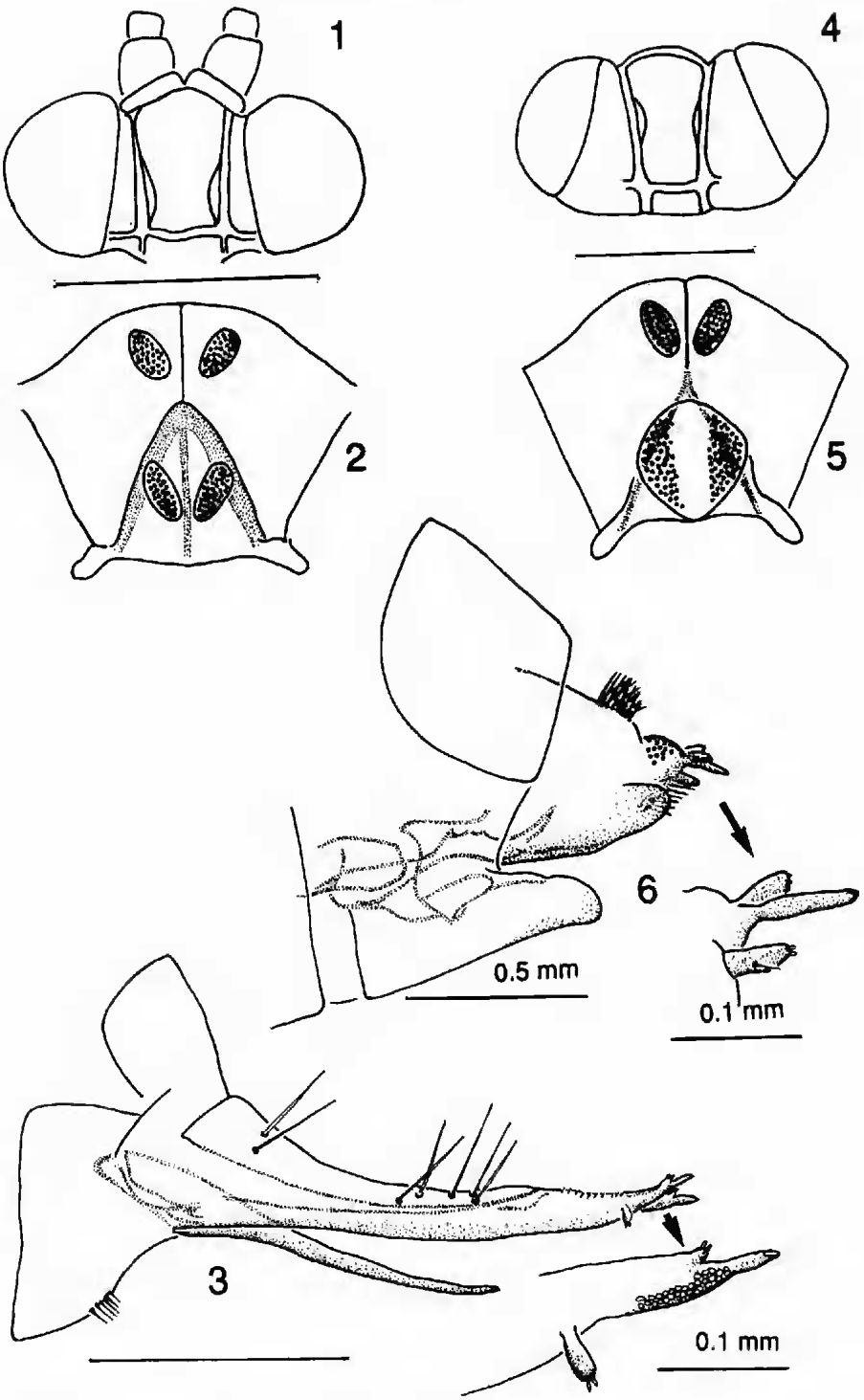


Figs 1-3. *Hyalopsyche disjuncta* Neboiss, female: 1, dorsal head showing tentorium; 2, mesothorax, dorsal view; 3, genitalia, lateral view.
Figs 4-6. *Phylocentropus lucidus* (Hagen), female: 4, dorsal head showing tentorium; 5, mesothorax, dorsal view; 6, genitalia, lateral view.
Scale bars = 1 mm, unless otherwise indicated.

M5 dissecting microscope and a Wild M20 compound microscope.

Material is deposited in the following institutions: Australian National Insect Collection, Canberra (ANIC); Museum of Victoria, Melbourne, (NMV); Northern Territory Museum of Arts and Sciences, Darwin, (NTM); and Queensland Museum, Brisbane, (QM).

Systematics

Hyalopsyche disjuncta Neboiss, 1980
FIGS 1-3, 7-13, 16, 18-21

Hyalopsyche disjuncta Neboiss, 1980: 357-361; Figs 1-8. Holotype male, N. Queensland, 29.iv.1979, NMV.

Material examined: N. Queensland: 1 ♂, 11° 50′S 142° 30′E, Bertie Creek, at Telegraph Crossing, 5.ii.1992, D. Cartwright and A. Wells, NTM; 2 ♂♂, 2 ♀♀, 11° 50′S 142° 30′E, Dulhunty River, at Telegraph Crossing, 8-9.ii.1992, D. Cartwright and A. Wells, NMV; 2 ♂♂, 1 ♀, 11° 39′S 142° 28′E, McDonnell-Cockatoo Creek jn, 18.ii.1992, D. Cartwright and A. Wells, NTM; 13 ♂♂, 5 ♀♀, 11° 44′S 142° 29′E, Gunshot Creek, at Telegraph Crossing, 17.ii.1992, D. Cartwright and A. Wells, QM; 11 ♂♂, 8 ♀♀, same loc. and collectors, 14-15.ii.1992, QM; 5 ♂♂, 15 ♀♀, same loc. and collectors, 18-19.ii.1992, NMV; 21 ♂♂, 4 ♀♀, same loc., 4-5.iv.1992, M. Crossland, ANIC; 31 ♂♂, 19 ♀♀, same loc. and collector, 10-11.iv.1992, NMV; 1 pupa, same loc., D. Cartwright and A. Wells, 18.ii.1992, NTM; 2 larvae, same loc. and collectors, NTM; 7 larvae (1 reared to adult ♀), 1 pupa, same loc. and collectors, 19.ii.1992.

Neboiss (1980) illustrates the general body features of male *Hyalopsyche disjuncta*, and gives anterior wing length as 6 mm, but in our samples male anterior wing length ranges from 4.3-6.2 mm. Females conform with males in general features, including reduced maxillary palpi and warts on the mesothorax (Fig. 2), but are considerably larger. An additional feature, the tentorium, is figured (Fig. 1): its arms are well developed, with inner lateral flanges posteriorly, and the posterior bridge complete.

Female (Figs 1-3). Anterior wing length 6.0-8.0 mm. Genitalia in the form of a slender, elongate, non-retractile ovipositor (Fig. 3). Sternite VIII not subdivided, external gonopod of segment VIII slender, tapered, reaching almost to tip of segment IX. Posteriorly segment X is divided to form a pair of distal lobes, each with apical cercus and one papilla partially fused on inner margin, the second projecting ventrally from the outer margin at about the level of division of segment X.

Larva (mature) (Figs 7, 8, 12, 13, 16, 18-20). Campodeiform, slender, elongate, (Fig. 7). Head, pronotum, limbs and anal claws brown-yellow or pale brown, dorsal margin of prothorax and strengthening ridges of thoracic pleura black, rest of body pale. Body length 6.0-14.8 mm, head capsule width 0.60-0.88 mm. Head round in dorsal view (Fig. 12); fronto-clypeus sub-triangular, extending to posterior of head capsule, anterior margin rounded, tentorial pits situated posteriorly; labrum broadly rounded with few setae, anterior margin finely divided. Mandibles (Fig. 16) stout, dissimilar, each with differing numbers of denticles apically and on inner distal margin, and with a dense penicillus medially on inner margin, antero-lateral margins crenulate; right mandible rugose antero-dorsally. On ventral head (Fig. 13), anterior ventral apotome (gula) short, forming an isosceles triangle; submentum rounded anteriorly, paired setae situated subapically; maxillary palps relatively slender, lobus internus broad, obliquely truncate in dorsal view, and bearing a brush of hair apically; labium modified to form a slender, elongate spinneret, about ⅔ as long as head capsule, labial palpi absent.

Prothorax only with sclerotised tergite. Fore trochantin fused to pleuron (Fig. 18). Mesosternum (Fig. 8) with a pair of elongate sclerites posteriorly.

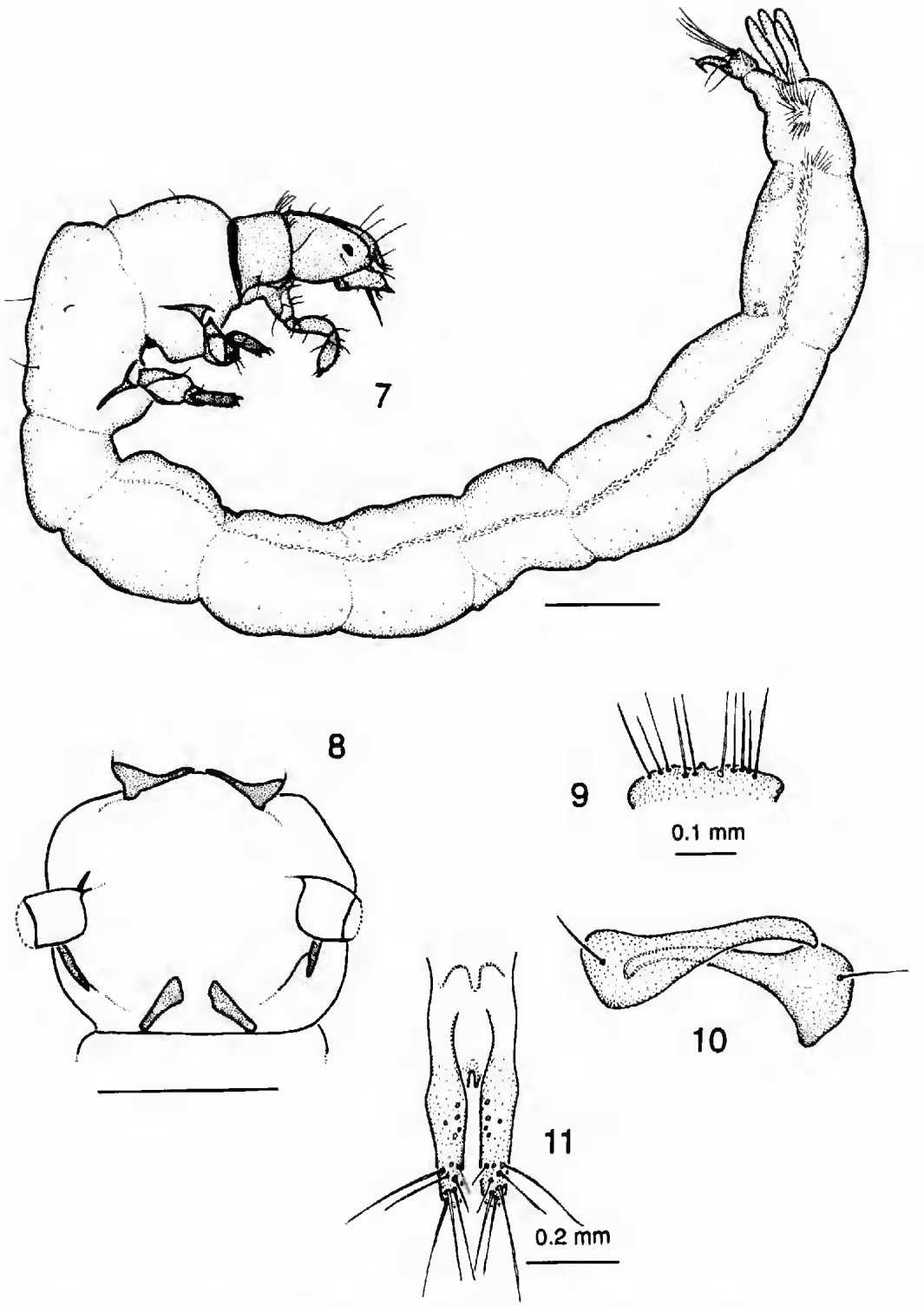
Legs (Figs 18, 19) short, flattened, tarsi with dense fringes of setae, claw on fore limb strongly curved. Fore tarsus with an adpressed row of modified setae on the mesial margin.

Abdomen elongate, with a lateral fringe of fine setae, without gills, but with a group of anal papillae (Fig. 7); anal prolegs elongate, with cluster of long setae anterior to the slender strongly curved anal claw (Fig. 20).

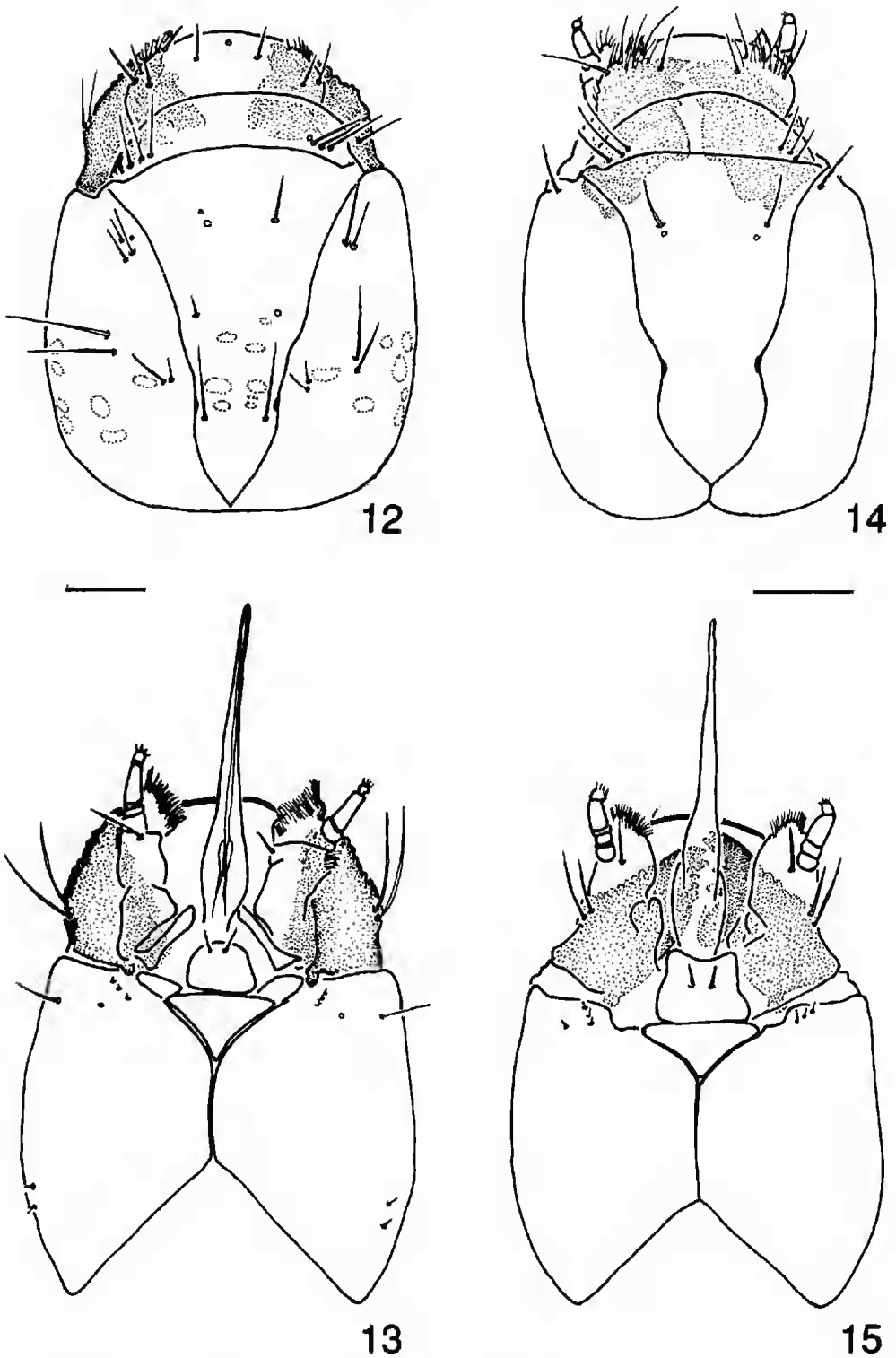
Pupa (Figs 9-11, 21). Length 7.5-10.3 mm. Labrum (Fig. 9) short, with a small marginal papilla apico-mesally. Mandibles (Fig. 10), simple, slender, curved. Hook plates (Fig. 21) with 3-5 denticles, on abdominal segments III-VIII, posterior plates on segment V only, developed into hand-like processes. Posterior abdomen (Fig. 11) divided into two simple setose lobes.

Biology. Larvae and pupae were extracted from fragmented silken tubes. The exact architecture of the larval dwelling is unknown, but the branched portions of tubes appear to have all the features of the tubes of *Phylocentropus placidus* (see Wallace *et al.* 1976) and *P. carolinus* Carpenter (see Wiggins 1977, Fig. 15.4D). (Such features are also shared by *Protodipseudopsis* sp. (un-named) as illustrated by Gibbs (1968, Fig. 3)). The architecture of the *Hyalopsyche disjuncta* dwelling is probably similar: a blunt-ended vertical branch with a small opening projected into the flow, a series of connected cross tunnels, and a dilated net chamber.

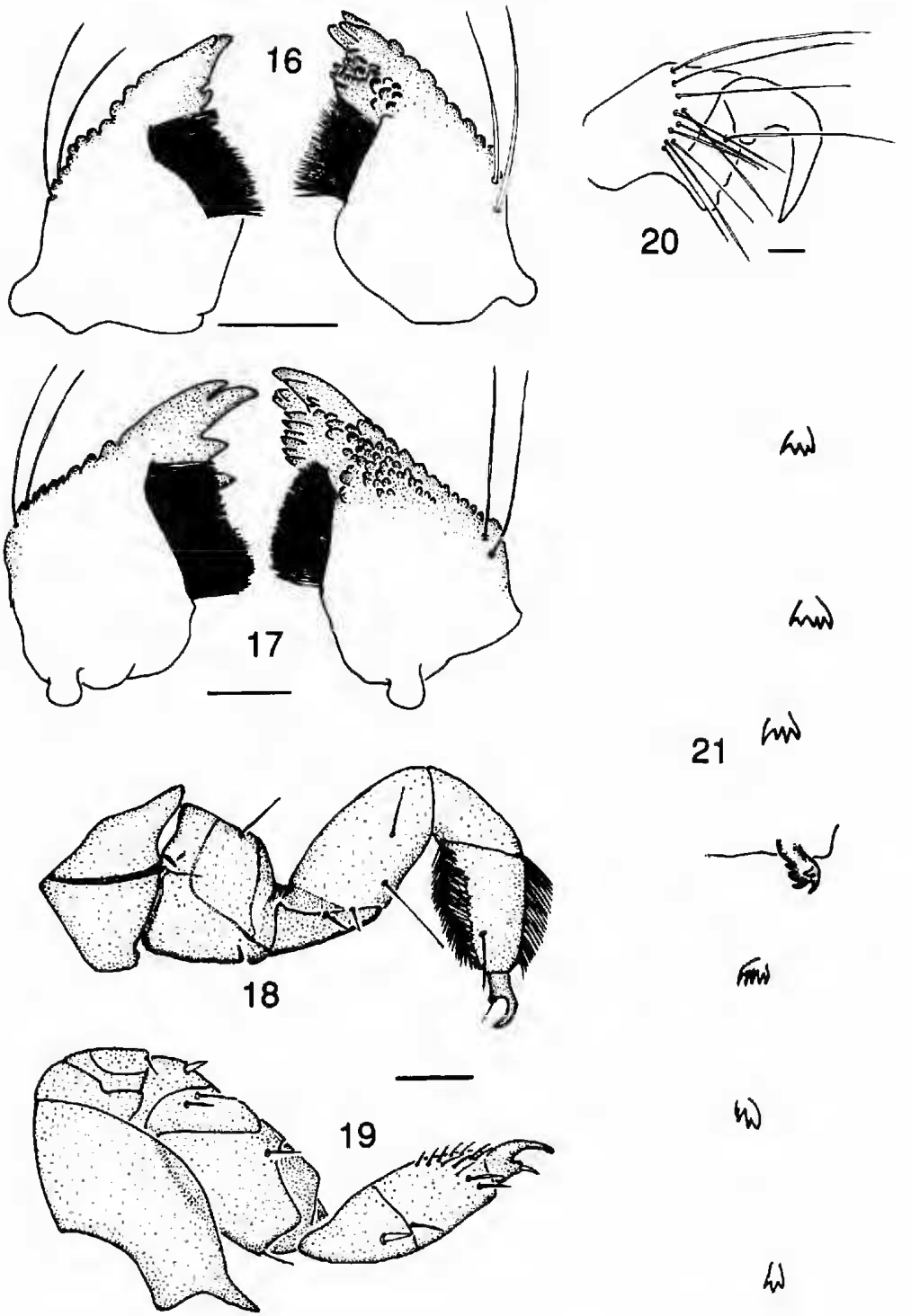
Habitat. Larval tubes were collected from a small stream with a rather unstable base of coarse sand. The dwelling tubes were found attached to logs amongst deeply packed sand and litter, usually in situations where the litter, trapped against logs embedded in the



Figs 7-8. *Hyalopsyche disjuncta* Neboiss, larva: 7, whole animal, lateral view; 8, mesosternum.
Figs 9-11. *Hyalopsyche disjuncta* Neboiss, pupa: 9, labrum; 10, mandibles; 11, posterior abdomen.
Scale bars = 1 mm, unless otherwise indicated.



Figs 12, 13. *Hyalopsyche disjuncta* Neboiss, larval head, dorsal and ventral views.
Figs 14, 15. *Phylocentropus* sp., larval head, dorsal and ventral views.
Scale bars = 0.1 mm.



Figs 16, 17. *Hyalopsyche disjuncta* Neboiss and *Phylocentropus* sp., larval mandibles,. dorsal view.
Figs 18-20. *Hyalopsyche disjuncta* Neboiss, larva. 18, foreleg and proleuron; 19, midleg; 20, anal proleg.
Fig. 21. *Hyalopsyche disjuncta* Neboiss, pupal hook plates, right side.
Scale bars = 0.1 mm.

sand, was beginning to decompose. Collections of adults were obtained at lights beside small and larger streams; the smaller streams generally were almost completely shaded by the canopies of riparian trees, the larger streams were open.

Discussion

Comparisons of features of larval *Hyalopsyche disjuncta* with those of *Phylocentropus placidus*, *P. lucidus* and *P. carolinus* (from Ross & Gibbs 1973 Fig. 2; Wiggins 1977 Fig. 15.4D; and this work, Figs 14, 15) reveal extraordinarily close similarities between species in the two genera, in derived or specialised features. In general form the heads are similar (compare for example Figs 12, 13 and *Phylocentropus* sp., Figs 14, 15); mandibles of all species are stout, with rugose sculpturing dorsally, albeit on only the right mandible in *H. disjuncta*; ventral sclerites differ slightly, with the submentum of *H. disjuncta* rounded rather than subquadrate; the *lobus internus* of the maxillary palp of *H. disjuncta* is broad and apically truncate rather than tapered and rounded; labia are modified to form virtually identical slender, elongate spinnerets. Thoracic features, too, show close resemblance and the highly specialised legs differ only in the exact shape of the specialised setae adpressed to the mesal margin of the fore tarsi. *H. disjuncta* lacks gills but conforms with *Phylocentropus* species in form of anal prolegs and their claws. The larval niches appear to be identical.

Pupae are relatively uninformative: mandibles of *H. disjuncta* resemble those illustrated by Ross (1944, Fig. 204) for *P. placidus*. Little information is available on pupae of *Phylocentropus*.

Some of the above features occur in other caddis larvae. For example, specialised elongate spinnerets are seen in larvae of some Psychomyiidae and some Ecnomidae, although in these families the spinnerets are proportionally shorter than in *Phylocentropus* and *Hyalopsyche*. Simple anal claws also occur elsewhere, but are probably plesiomorphous. The highly modified, flattened limbs, the form of the mandibles and the larval niche are found only in *Hyalopsyche*, *Phylocentropus*, *Protodipseudopsis* and *Dipseudopsis*.

The probability of such a suite of resemblances evolving by convergence are slim. The simplest hypothesis is that these taxa arose from the same specialised ancestral stock.

Adult characters do not concur with those of the larvae. No clear synapomorphies can be recognised, which is the very reason that placement of these genera has been confused for so long. Among adult features several small differences in general body features can be observed between *Hyalopsyche* and *Phylocentropus*, such as the arrangement of setae on the meta-scutellum (see Figs 2, 5) and the absence of several crossveins in the wings; as well as other more major ones, such as shape of head, position of antennae, reduction of maxillary palpi and form of genitalia. These differences probably represent autapomorphies for the particular genera. The wings of *Hyalopsyche* can be derived from those of *Phylocentropus*, which closely resemble polycentropodid wings, simply by loss of several crossveins; those of *Phylocentropus* probably represent the plesiomorphous form. Similarities such as form of the tentorium (Figs 1, 4) are probably also plesiomorphous.

Superficially, the female genitalia of *Hyalopsyche disjuncta* (Fig. 3) appear to be strikingly different from those of *Phylocentropus placidus* (Fig. 6). Yet upon close examination, similarities are apparent, particularly in the cerci and papillae. Derivation of the *Hyalopsyche* form from that of *Phylocentropus* requires only simple elongation of the arrangement seen in *Phylocentropus*, probably adapting *Hyalopsyche* females for oviposition into sand or crevices. Investigation of the female of *Dipseudopsis indica* McLachlan during this study, indicated that on the basis of female genitalia and wing form, *Phylocentropus* and *Hyalopsyche* are closer than *Dipseudopsis-Hyalopsyche*.

Association of females and larvae of a species in *Hyalopsyche* has helped to stabilise the higher level taxonomy of this genus, placing it in the family Dipseudopsidae. On the basis of studies reported here and examination of the literature, we suggest that *Hyalopsyche* and *Phylocentropus* represent sister groups.

Ross & Gibbs (1973) suggested on the basis of similarities between *Phylocentropus* and Polycentropodinae that *Phylocentropus* is closer to the ancestral stock than other Dipseudopsinae (=Dipseudopsidae) and, given its occurrence in the Oligocene Baltic ambers, they suggested a Eurasian origin for the subfamily (=family). We have not found evidence with which to dispute this contention – the single north-eastern Australian species in *Hyalopsyche* is undoubtedly of Oriental origin. Careful phylogenetic analyses in the future will elucidate intrafamilial relationships, but at last the family Dipseudopsidae is reunited.

Acknowledgments

We thank the Royal Geographical Society of Queensland for providing the opportunity and financial support for field work at "Heathlands" and the surrounding Jardine River area of Cape York, and for the generous help and assistance given to us by members of the Society during our stay at "Heathlands".

D. Cartwright's work was undertaken with backing from his family, and A. Wells' with backing from the Northern Territory Museum of Arts and Sciences, Darwin. We are grateful to both parties.

Dr J.S. Weaver of the University of New Hampshire, USA, kindly provided material of *Phylocentropus lucidus* and *Dipseudopsis indica* from his collection for comparisons. Adults of *Phylocentropus placidus* and larvae of *Phylocentropus* sp. were made available by Dr J. Morse, on loan from Clemson University, USA.

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